



The Influence of Professional Engineering Organizations on Women and Underrepresented Minority Students' Fit

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Specialty section:

This article was submitted to
STEM Education,
a section of the journal
Frontiers in Education

Received: 09 August 2021

Accepted: 29 November 2021

Published: 25 January 2022

Citation:

Campbell-Montalvo R, Kersaint G, Smith CAS, Puccia E, Sidorova O, Cooke H, Wao H, Martin JP, Skvoretz J, MacDonald G and Lee R (2022) The Influence of Professional Engineering Organizations on Women and Underrepresented Minority Students' Fit. *Front. Educ.* 6:755471. doi: 10.3389/educ.2021.755471

Our work focuses on women and underrepresented minority (URM) students' cultural models of engineering success (CMES) or beliefs about doing well in engineering. Because of its consequential effect on persistence, we pay special attention to the fit domain of CMES—student feelings of belonging in their engineering program. We examine 1) how student fit is affected by participatory social capital (i.e., participation in professional engineering organizations [PEOs] that have as part of their mission a goal to assist students in their STEM education and careers), as well as 2) the factors that affect students' decisions to participate in PEOs. Due to the traditional prioritization of majority norms in engineering programs, women and URM students' CMES may conflict with the cultures manifested in engineering departments. Analysis of interviews with 55 women and URM engineering students shows that PEOs, particularly gender- and race-focused PEOs, affect students' feelings of fit. PEOs affect student fit positively and primarily through expressive social capital—emotional support wherein students feel they fit in because PEOs provide a sense of community and opportunities to be around successful women and URM engineers. PEOs also allow students to build instrumental social capital, such as academic and professional skills, including networking and knowledge development. Encouragement from others and their desire to be around people like themselves played a central role in students joining PEOs. However, students identified time, financial, and fit issues that discouraged them from participating in PEOs. This investigation illuminates how socially distant others from PEOs affect student fit, extending previous work which uncovered how more proximal others affect fit as well as previous work finding that URM students participating in PEOs were more likely to persist in their engineering program. Research, theory, and practice applications are presented.

Keywords: social capital, belonging, STEM-Science Technology Engineering Mathematics, women, black students

INTRODUCTION

For the last half-century, researchers have investigated differential declaration and persistence rates in STEM majors across groups, including gender and racial/ethnic groupings. During this period, studies tended to locate differences in STEM declaration and persistence within an individual's characteristics, such as their interest or ability (e.g., Goldrick-Rab, 2006; Faulkner, 2009; Cech et al., 2011). In addition, many of these studies used the pipeline model, which focused on how individuals and groups moved through education into careers (Metcalf, 2010). More recently, scholars have found that individual variables, such as aptitude and interest, do not alone account for STEM declaration and persistence (Acker and Feuerverger, 1996; Seymour, 1999; Margolis, et al., 2000; Summers and Hrabowski, 2006; Sax, 2008; Hill, et al., 2010; Shapiro and Sax, 2011). Therefore, researchers who aim to explain STEM persistence have shifted their focus by adopting structural explanations that take into account broader social forces, such as discrimination, economic inequality, and the limited representation of women and underrepresented racial minority (URM) students in the STEM curriculum, to explain the lower proportions of women and URM engineering students and workers (McGee, 2020; Campbell-Montalvo et al., 2021). For instance, student participants in the landmark Seymour and Hewitt (1997) study cited disappointment with the culture of the field or reduced confidence as reasons for leaving STEM. Weston (2019) bolstered Seymour and Hewitt (1997) and found that lack of fitting in socially due to program structure or difficulty finding assistance to address problems were reasons students decided to leave STEM. Thus, the structure of university and department program culture, including STEM norms, has been shown to be a factor in retaining students.

We posited that there may be structural incongruities between the understandings of women and URM students about how to do well in engineering and institutional norms manifested in engineering department culture (Smith et al., 2015). Students' understanding of how to do well in engineering, dubbed Cultural Models of Engineering Success (CMES), includes student understanding of how they fit in their engineering program (Smith et al., 2015). Traditionally, engineering program norms prioritize the experiences of dominant groups, which impacts the ability of engineering departments to attract and retain a diversity of students (Goldrick-Rab, 2006; McGee, 2020).

Echoing Weston (2019) that highlights the importance of assisting students in addressing problems encountered in their STEM degree programs, other research reveals that students linked their disappointment with STEM majors to a lack of advice received from specific influential people in their degree programs, such as engineering professors (Nyquist et al., 1999; Marra et al., 2012) and advisors (Prieto et al., 2009; Sutton and Sankar, 2011; Schmidt, et al., 2012). Social network analysis allows researchers to map relationships between students and such influential people. In such cases, students are referred to as the "ego" and comprise a focal point, while the influential people to whom student relationships are mapped are known as the "alters" (Burt, 1982; Lin, 1999; Son and Lin, 2012; Tulin et al.,

2018). Students, including Black women in mathematics fields (Brown and Josephs, 1999; Morganson et al., 2010; Borum and Walker, 2011; Evans et al., 2011; Joseph et al., 2017; Leyva et al., 2021), who have access to homophilous alters (i.e., same-gender alters, same-race alters) receive culturally sustaining guidance when they experience obstacles and affirmation, which aids their persistence in the often unwelcoming STEM climate (Campbell-Montalvo et al., 2021). Studies that examine the intersection of STEM department culture, women and URM student values, and social capital from alters who can help mitigate dissonance between department culture and women and URM student values offer insight into the structural factors shaping engineering persistence. Our research shows that women and URM students benefit from access to resources and advice from alters in students' social networks (i.e., network-based social capital), as well as alters in the organizations in which they participate (i.e., participatory social capital) (Skvoretz et al., 2020; Campbell-Montalvo et al., 2021; Puccia et al., 2021; Smith et al., 2021). For example, Puccia et al. (2021) identified the role network-based social capital garnered from parents' advice played in students' declaration and persistence in their engineering majors. Parental advice included statements indicating their belief that their child could graduate with their engineering degree or encouraging them to persist even when their program became difficult. Likewise, Campbell-Montalvo et al. (2021) found that students' feelings of fit in engineering, especially Black students' feelings of fit, improved as they received advice from people in their social networks, including parents, high school teachers, and other alters. In such cases, alters explicitly warned students that others in engineering would negatively prejudice them because of their gender and/or race. Students who received such warnings were better able to negotiate fit when they experienced microaggressions and/or felt excluded. Similarly, based on interviews with 38 Black and Latinx engineering students, Johnson showed that ties that Black and Latinx students make with engineering peers of color "helped offset the psychosocial burden of ethnoracial marginalization experienced on a predominantly white campus and provided important academic support" (2018, p. 15). Collectively, these studies suggest that homophilous alters help students identify processes of marginalization, which in turn, helps students resist them (Secules et al., 2018).

Participatory social capital refers to advice from people students meet by participating in STEM professional societies, such as Professional Engineering Organizations (PEOs), including those that are gender-focused (i.e., Society of Women Engineers [SWE]) or race/ethnicity-focused (i.e., National Society of Black Engineers [NSBE] or the Society for Hispanic Professional Engineers [SHPE]). Researchers have reported the value of PEOs to women and URM students, highlighting the role that participation in PEOs plays in reducing their feelings of isolation due to being numerical minorities (Espinosa, 2011; Ong et al., 2018; Campbell-Montalvo et al., 2021; Smith et al., 2021), and increasing URM students' persistence in their program (Smith et al., 2021). In our previous work, we analyzed two rounds of survey responses from ~2,186 engineering students, in which half of the participants

engaged in PEOs (Smith et al., 2021). We found that Black and Latinx students who participated in race/ethnicity-focused PEOs (such as NSBE or SHPE) were more likely to persist in their engineering program (i.e., still be enrolled) in their second year than Black and Latinx students who did not participate in such organizations. Similarly, in a previous study using interviews with 44 diverse engineering juniors and seniors, the majority of women and URM students believed that their connections through their memberships in professional societies contributed to their persistence by providing resources such as free tutoring and information about professors' teaching and exam styles (Borman, et al., 2010; Chanderbhan-Forde et al., 2012). The documented impacts of participatory social capital are relevant to informing research and structural approaches aimed at broadening participation in STEM, particularly for Black engineering students who, when compared to women and Latinx students, had the highest rates of involvement in gender- or race/ethnicity-focused PEOs (Smith et al., 2021) and who experience some of the worst STEM department climates (Campbell-Montalvo et al., 2021).

At this juncture, what remains unclear is how PEOs promote student persistence in STEM by reducing isolation or developing students' sense of fit, and whether PEOs mainly do so through the same mechanisms as network-based social capital (i.e., warnings of discrimination) similarly across groups. Thus, the goals of the present study are to elucidate the mechanisms through which PEOs and engineering persistence are related, including the effect of PEOs on student CMES (particularly fit) across groups, and investigate the factors that encourage or dissuade students from joining PEOs. We draw on interview data from 55 women and URM engineering undergraduate students to answer the following research questions:

- (1) Across groups, how does participating in PEOs affect students' CMES?
- (2) What factors affect students' decisions to join or not to join PEOs?

We aim to extend research at the nexus of STEM persistence, professional STEM societies, social capital, and fit/sense of belonging by investigating the development of fit through participatory social capital. Insights from this study can be used by universities and STEM professional societies to develop intersectional interventions and extend their efforts (both in student chapters and the parent organizations), offer encouragement and justification for participating in these societies, and support efforts to reduce obstacles to participation to help students take advantage of documented benefits of joining PEOs.

Theoretical Perspective: CMES (Fit) and Social Capital

By examining the patterned ways in which PEOs affect students' feelings of fit based on the ways students negotiate the engineering department's culture with the values they bring, we situate our work within 1) the fit domain of CMES, a

particular type of cultural model of education (Smith et al., 2015), and 2) social capital theory (Lin, 2001), specifically participatory social capital as described in Skvoretz et al. (2020). Cultural models are how people structure their cognitions about their life experiences in particular areas, such as gender or education (D'Andrade, 1995; Shore, 1996). Cultural models are different from regular knowledge because they are (to an extent) shared among groups and can differ between gender and racial/ethnic groups (Holland and Eisenhart, 1990; Mukhopadhyay, 2004; Fryberg and Markus, 2007; Fryberg et al., 2013). Broader society and particular people with whom an individual comes in contact, such as family members and teachers, shape individuals' cultural models. Cultural models are internalized and mediate how individuals interact with others (Strauss and Quinn, 1997). CMES includes the groups of assumptions and ideologies people have about how individuals in schools interact and should behave (Fryberg and Markus, 2007; Fryberg et al., 2013). Specifically, CMES relate to how students understand engineering education and the people involved in the schooling process, including their understandings about how to be a successful student, how relationships between instructors and students function, and the role of education in personal development (Fryberg and Markus, 2007; Fryberg et al., 2013; Smith et al., 2015).

The CMES domain of "fit" is of particular interest as a potential influencer of engineering persistence. Fit refers to a person's sense of belonging, including feelings of inclusion or welcome (Campbell-Montalvo et al., 2021). Such feelings may vary in engineering contexts, such as the lab or the classroom (McGee, 2020). We conceptualize fit as a structural outcome experienced by students who feel welcomed or like they belong based on their STEM department or program culture. Fit is affected by the environment cultivated by a STEM department's policies and actions, patterns in social relations (e.g., microaggressions), and identities (e.g., the underrepresentation of women and people of color among engineering faculty). However, fit is not considered an individual characteristic rooted in a student's abilities to match "correct" norms and values. Instead, feelings of fit are a consequence of how well universities and engineering programs make spaces for, include, and validate a range of students (Campbell-Montalvo et al., 2021). Because engineering and STEM cultures are not founded upon the cultural experiences and traditions of women and people of color, resulting in the anti-blackness of STEM (Bullock, 2017; Cedillo, 2018; Martin et al., 2019; Vakil and Ayers, 2019; Nxumalo and Gitari, 2021), women and URM students may be less likely to fit in engineering and STEM programs (Goldrick-Rab, 2006).

Social capital theory explains how individuals access resources through webs of connections to people that enable them to accomplish goals that they might not have accomplished on their own (Lin, 2001; Van der Gaag and Snijders, 2005; Lin, 2008). Social capital is relational, meaning that knowledge and skills are transmitted through relationships between people in the same network. Due to social inequity and patterns in social interaction, social

capital may differ based on an individual's gender, age, and ethno-racial background (Skvoretz et al., 2020). Thus, we use the terms 'network-based social capital' and 'participatory social capital' to locate one's access to social capital by how they are situated in relation to other people in a social context, which may determine how and what type of resources are received. In network-based social capital, alters are connected to an individual through that person's daily life, and include family members, peers in the same major, professors, and the like (Skvoretz et al., 2020). Because of their potentially closer social proximity, network-based alters may be more able to offer resources unique to the individual, such as advice about classes or emotional support (Borman et al., 2010; Chanderbhan-Forde et al., 2012; Campbell-Montalvo et al., 2021; Puccia et al., 2021). Participatory social capital is specific to an individual's involvement in an organization, such as a PEO, that has as part of its mission a goal to make resources available to its members (Skvoretz et al., 2020). Students can access various resources based on the PEOs they choose to join and through the department of their major. Alters from PEOs, who may not be in the individual's social network and might be less socially proximal, may often offer advice about classes and career-related skills (Smith et al., 2021).

Within social capital, it is also essential to distinguish the types of resources and support provided to students, including instrumental social capital and expressive social capital (Puccia et al., 2021). Instrumental social capital is activated when an individual gains new resources specific to a goal (e.g., academic advising, help with homework). Expressive social capital is the support and encouragement provided to support an individual's emotional wellbeing (e.g., reassurance before an exam) (Van der Gaag and Snijders, 2005). Expressive social capital is likely a primary driver of improvement in fit given the emotional and relational characteristics of fit and the potential of expressive capital to offer emotional support needed in the STEM environment, often unwelcoming to marginalized students (Campbell-Montalvo et al., 2021). Puccia et al. (2021) found that both the instrumental and expressive social capital provided by parents was influential in women and URM students' declaration of an engineering major. Smith et al. (2021) found that participation in PEOs provided instrumental and expressive social capital, which was beneficial to women and URM students because it led to 1) academic and social integration, including gaining a sense of belonging or fit; 2) connections with potential employers; and 3) opportunities to develop professional and career-related skills. Overall, expressive and instrumental social capital positively garnered through participating in PEOs affected the chances that women and URM students would stay in their engineering programs.

In (Campbell-Montalvo et al., 2021), which involved the same sample of 55 students as in the current study, we showed how acquired network-based social capital helped students feel they fit because alters warned women and URM students, particularly Black students, that they would experience discrimination. These

TABLE 1 | PEO participation and participant characteristics of interviewees ($n = 55$).

PEO participation	Race/Ethnicity	Gender	University type
AIAA	White	Woman	PWI 1
AICChE	White	Woman	PWI 2
ASCE	Latinx	Man	PWI 3
ASME	Black	Man	PWI 2
ASME	Middle Eastern	Man	PWI 2
ASME, ASCE	White	Woman	PWI 1
NSBE	Black	Man	HBCU
NSBE	Black	Man	HBCU
NSBE	Black	Man	PWI 1
NSBE	Black	Man	PWI 2
NSBE	Black	Man	PWI 2
NSBE	Black	Man	PWI 2
NSBE	Black	Man	PWI 2
NSBE	Black	Woman	HBCU
NSBE	Black	Woman	PWI 1
NSBE	Black	Woman	PWI 1
NSBE	Black	Woman	PWI 2
NSBE, ASCE	Black	Man	PWI 1
NSBE, IEEE	Black	Woman	PWI 2
SAE	Black	Man	HSI
SHPE	Latinx	Man	HSI
SHPE	Latinx	Man	PWI 1
SHPE	Latinx	Man	PWI 2
SHPE	Latinx	Man	PWI 2
SHPE, IEEE	Latinx	Man	PWI 3
SWE	White	Woman	PWI 1
SWE	White	Woman	PWI 2
SWE	White	Woman	PWI 3
SWE, AICChE	White	Woman	PWI 1
SWE, AICChE	White	Woman	PWI 2
SWE, ASCE	Latinx	Woman	PWI 1
SWE, BMES	White	Woman	PWI 1
SWE, SHPE, ASCE	White	Woman	HSI
No	Black	Man	HBCU
No	Black	Man	PWI 2
No	Black	Woman	HBCU
No	Latinx	Man	HSI
No	Latinx	Man	HSI
No	Latinx	Man	HSI
No	Latinx	Man	PWI 1
No	Latinx	Man	PWI 2
No	Latinx	Man	PWI 2
No	Latinx	Man	PWI 2
No	Latinx	Man	PWI 2
No	Latinx	Man	PWI 2
No	Latinx	Man	PWI 3
No	Latinx	Woman	PWI 1
No	Latinx	Woman	PWI 2
No	Middle Eastern	Man	PWI 1
No	Middle Eastern	Man	PWI 2
No	Other	Man	HSI
No	Other	Man	PWI 3
No	Other	Woman	HSI
No	White	Woman	PWI 1
No	White	Woman	PWI 2
No	White	Woman	PWI 2
No	White	Woman	PWI 2

warnings helped students understand these events when they happened and cope, thereby preventing a loss of fit. However, that study focused primarily on the influence of network-based social capital. Likewise, while Smith et al. (2021) showed PEOs helped students stay in STEM, it did not model the mechanisms through

which PEOs were beneficial to students, such as through fit or other variables, to understand the levers causing the observed effectiveness of PEOs in persistence for URM students. To address these gaps and complement earlier work, we investigate how different social locations of social capital (i.e., network-based, participatory) offer varying forms of social capital (i.e., instrumental, expressive) that can influence fit to impact persistence across groups.

METHODS

Participants

We interviewed a subsample of the 2,186 engineering students who were first-year students in 2014 and who completed a survey as part of our larger longitudinal research project (see Skvoretz et al., 2020 for a description of the larger survey project). To recruit the 55 women and URM students we ultimately interviewed, we contacted students from five of the 11 universities who participated in our research. The five universities included three Predominantly White Institutions (PWIs), one Hispanic-Serving Institution (HSI), and one Historically Black College/University (HBCU). We selected these universities because they represented a mix of students and contexts. In Puccia et al. (2021) we describe processes through which we determined which survey participants we would recruit for interviews; briefly, we contacted students with higher and lower levels of social capital based on their first completed survey.

A total of 55 students agreed to be interviewed. Thirty-two interviewees participated in PEOs, of them, 12 participated in NSBE, six in SHPE, and eight in SWE. Students' participation in PEOs was not a selection criterion. Interviewees included women of any racial/ethnic grouping as well as URM men. Their demographics were Latinx (15 men, three women), Black (11 men, six women), White (0 men, 14 women), Middle Eastern (3 men, 0 women), and other ethnicity/race (2 men, one woman). Forty-two of the interviewees were from the three PWIs, eight from the HSI, and five from the HBCU. Interviews were conducted during 2015, when participants were either finishing their first year or entering the second year of their engineering program. Interviewee characteristics, including PEO participation, are shown in **Table 1**.

Interview Protocol

Our semi-structured interview protocol was designed to answer our research questions about how CMES and social capital affect students' persistence in their engineering programs. Interview protocols were customized to each participant using their earlier survey responses about their alters. For example, we asked how people they identified on the previous survey (see Skvoretz et al., 2020) contributed to their persistence in engineering, and whether students followed advice from these mentors and how that advice helped them in engineering. We also asked students how they fit into their programs, given their gender and racial/

ethnic identities. The students were additionally directly asked whether they participated in professional societies and, if so, why they did or did not participate in them. We similarly asked students about the actions they had taken to be successful engineering majors. These items and additional probes yielded responses from students in which they described participating in PEOs and how it affected them. We asked participants to share examples during the interviews and used "tell me more" prompts to increase the amount of detail elicited (Bernard, 2011). Items from the interview guide included the following:

- (1) Can you give me an example of something that [the person they identified on their survey] said or did that influenced you during your first year as an engineering undergraduate?
 - (a) How did you act on this advice?
 - (b) How did this advice contribute to you remaining an engineering major?
- (2) As a [insert their self identifications from the survey], tell me how you fit into your engineering department.
- (3) Do you participate in any: study groups, research, communication with professors (e.g. office hours, networking), internships, or professional societies/organizations?
 - (a) Why or why not?
- (4) What have you done in college to be a successful engineering major?

Two Black women and one white woman conducted the interviews. If possible, we matched participants with interviewers of the same race/ethnicity as the participant. This study was conducted following protocols approved by the University of South Florida Instructional Review Board¹, including gaining signed informed consent from participants. Interviews lasted 1 hour or less, and most were conducted in person on campus. However, seven were conducted via videoconference for students unable to meet in person. Interviews were audio-recorded and transcribed verbatim. Participants received a \$25 Amazon gift card for their time.

Data Analysis

We used thematic analysis to find themes in the interview data based on previous research, patterns that emerged, and the data's relationship to the key components of the research questions (Braun and Clarke, 2006). A codebook was developed with primary and sub-codes using the literature on fit and social capital and the interview guides. After independently reviewing the interview transcripts, five members of the research team engaged in a group discussion to achieve consensus about the codes and their definitions. We refined the codebook through several iterations and discussions, and established intercoder reliability (both described in detail in

¹The study was initiated at University of South Florida and was later transferred to the University of Connecticut. The researchers were permitted to continue the study based on the protocols approved by the University of South Florida based on an authorization agreement between the two universities

Puccia et al., 2021). Two team members coded the 55 interviews, and another team member entered the codes into the program QSR NVivo 11.0. These steps above comprise the first phase through which this data was analyzed wherein all interviewee comments about professional societies were organized during the coding process into one code, “Participated or did not participate in professional societies.” Before we commenced with coding, the team agreed to apply this code to any salient mentioning of societies, and then further analyses would be undertaken to tease out additional trends.

Two research team members undertook the second phase of coding. They first read through all the interview data excerpts to which the “Participated or did not participate in professional societies” code had been applied. They then grouped these excerpts based on the frequency of occurrence, keyness to the research questions, or in relation to the reviewed literature, which resulted in the following preliminary themes emerging at this stage:

- Benefits of joining PEOs
 - Skills and collaborative benefits of getting involved (gaining experience, responsibility, leadership, etc.)
 - Knowledge benefits from PEO events, conferences, and learning from members
 - Networking and connection benefits
 - Job and professional advantages (e.g., getting an internship or job, having professional and career security and success)
- Reasons to join
 - Reputation of PEOs
 - PEOs helping with certification
- Participation, how people got involved in PEOs
- Barriers to participation in PEOs
 - Time constrains, conflict in schedules, other priorities
 - Readiness to be involved
 - Finances, cost
 - Did not take societies seriously or believe they were helpful (i.e., already had an internship)
 - Lack of interest or willingness to get involved, skepticism
 - Student perception that they would not be welcome at the PEO
- Things to do to be a successful engineering major (e.g., time management, studying, sleeping enough, working hard, scheduling, balancing work with pleasure, joining a PEO)
- Fit in engineering and in PEOs
 - Sense of belonging
 - Diversity
- Relationships with others
 - Mentor/mentee programs

Afterward, in the third phase, one of these two team members and a different team member further organized the data grouped in these above themes. In this phase, the researchers compared our current findings to the results of previous studies utilizing the same population and from which the participants of this study were selected (Puccia et al., 2021; Smith et al., 2021). In Smith et al. (2021), we performed inferential analyses on the larger pool of the 2,186 survey respondents and found that race/ethnicity-

focused PEOs improve engineering persistence for URM students. We were also able to determine the types of social capital provided by these PEOs by thematically analyzing open-ended survey data. These types of social capital guided the final phase of data analysis for the present article and include the following types:

- (1) “academic and social integration through academic support, such as developing time management skills and tutoring, as well as social networking, such as meeting other students and engineers of color some of whom become friends and mentors;
- (2) connecting with industry internships and employment opportunities through attendance at national conferences; and
- (3) professional resources for career development such as improving leadership skills, resume writing, and interview skills.” (Smith et al., 2021, p. 8)

In Puccia et al. (2021), we analyzed the same 55 interviews as in the present study, highlighting the instrumental (e.g., direct advice about accessing resources and strategies) and expressive (e.g., emotional support) social capital provided by parents. In this study, we drew upon the operational definition of expressive social capital for engineering students (Puccia et al., 2021), to identify themes focusing on how PEOs and alters provided emotional support through various mechanisms to help students persist in engineering, which are presented in the findings section.

In sum, because we recruited interview participants from the same pool of 2,186 survey participants described in Smith et al. (2021), our analysis sought to add nuance to previous findings and buttress the transferability of the findings from Puccia et al. (2021). Thus during analysis, we prioritized instances related to how PEOs enable students to network, how PEOs reduce isolation related to gender and race/ethnicity, and how PEOs provide access to professional and emotionally supportive resources, because such instances were identified as important in Smith et al. (2021). We then related these explanations to the notion of instrumental and expressive social capital identified in Puccia et al. (2021).

RESULTS

Regarding the fit domain of CMES (the first research question), we found that PEOs provided 1) expressive social capital, wherein students felt they belonged, primarily because they saw others like themselves in large numbers, and 2) instrumental social capital, wherein students gained valuable academic and professional skills, indirectly promoting their feelings of belonging in engineering. First, students discussed how PEOs provided a sense of community and allowed them to be around others like themselves and see them succeed in engineering. This provided students “a family” with whom to talk about a “shared struggle.” Students’ feelings of fit were further increased as they established friendships and gained validation

from their PEO. Second, PEOs provided students with instrumental social capital, including academic support and access to internships and employment by building professional networks, often with people like themselves. Students also developed leadership and time management skills through experiences in their PEOs.

Regarding our second research question, students provided three common reasons for joining PEOs. First, they were encouraged to do so by teachers, mentors, peers, and others in their social network. Second, they desired to join a community of people from the same racial/ethnic background. Third, they were motivated by opportunities to network with professional engineers and peers. In particular, connecting with homophilous alters was crucial reason why students wanted to join PEOs, and race/ethnicity-focused PEOs are a good source of them for URM students. Finally, students also recounted obstacles that inhibited them from joining or fully participating in PEOs. These included time constraints and scheduling conflicts, financial concerns, or a lack of fit.

Expressive Social Capital: Community and Seeing Other People Like Yourself in Engineering

The main expressive social capital finding related to how:

- Participation in PEOs provided women and URM students access to (often homophilous) others from whom they received expressive social capital that aided them in fitting in their engineering program.

Women- and race/ethnicity-focused PEOs allowed student members to be around others in engineering like themselves, which improved their fit as they navigated the field of engineering, a field traditionally dominated by white men. Specifically, alters students met through PEOs helped them feel like they were part of a community of people with whom they could discuss their struggles and find solutions to obstacles. In addition, being around others with similar characteristics aided students in making sense of the negative treatment they received from others. Ultimately, these homophilous alters helped students feel they belonged in engineering.

Women, particularly women who were not Black, identified SWE as a common source of support. For example, a Latinx woman at a PWI expressed that engineering is a field dominated by men and that joining SWE made it “a little bit more inclusive” for her:

SWE makes engineering a lot smaller. It makes it easier to relate to all these people and be able to understand the things that you’re going through and understand the struggles that even women feel in this kind of area.

Likewise, when asked if the resources provided by SWE offered a sense of camaraderie, a white woman at a PWI discussed the PEO’s newsletter.

Yeah, definitely. They do also send out a newsletter about a prominent woman engineering in the world, and they give a backstory on her and sometimes they’ll mention other engineers here at my university.

When asked a follow-up question about whether that newsletter helped her feel like she fit in or had a more established place as a woman in engineering, the woman agreed:

I think, yeah, a more established place as a woman in engineering. Especially as the years progress and women in STEM programs becomes more prominent, I definitely think that’s how I feel. Maybe not necessarily like, ‘Oh I fit in,’ but it’s like, ‘I belong here whether other people [see that or not].’

Women who did not participate in SWE for various reasons, such as already participating in gender-focused opportunities or not “being into clubs,” also acknowledged that SWE often benefits its members. For instance, a white woman at a PWI acknowledged that other women may feel encouraged by such societies, “I don’t think that I could be a part of another all-female thing [in addition to my Women in Science and Engineering learning community], but I know that it’s encouraging for [them].” Likewise, a white woman at a PWI shared that she had not participated in SWE much because “she is not into clubs” but she thinks that joining a club is beneficial for other students who need support. She said, being in PEOs “could be helpful if you’re struggling being a woman [in engineering], . . . if you’re struggling with coping and being in college.”

URM students, particularly Black students, noted the importance of joining a race/ethnicity-focused organization. For example, when asked about the role that NSBE has played in her experience in her engineering program, a Black woman attending a PWI described the PEO’s essential role in securing her fit:

Oh my gosh, huge role . . . just having that family, that community, that support system is, it’s almost essential. NSBE has given me mentors, role models, encouragement.

Likewise, a Black woman at a PWI said NSBE is “like a family” in a way that “just blends well,” and she enjoyed making shared memories with NSBE peers.

Other Black students talked at length about their attraction to NSBE because it was specifically inclusive of Black engineers. For example, a Black woman at a PWI shared:

I feel like I fit well . . . especially because there aren’t a lot of black people at all in engineering so when I see, at least at the NSBE meetings, when you see all the people that are doing it, it definitely is like, ‘Okay there’s other people just like me doing it’.

Further discussing how seeing other Black students succeeding in engineering creates a feeling of fitting into engineering and pride

in being one of those students, a Black woman attending a PWI described her perceptions of NSBE. NSBE conferences and events provided a sense of “comfort.” She shared:

The people that you meet, the amount of people that you meet at [the] conference [...] When you go to [the] conference it’s National Society of Black Engineers, it’s mainly Black engineers. And it’s nice to see how many are really pursuing the same major, the same field actually, so that’s comforting. And because there’s not many of us, that’s the main reason why [you participate], to see more of you pursuing what you do.

A Black man at a PWI specifically connected his participation in NSBE to his fit, noting that “there’s even a society, a whole society of Black engineers, so I think we fit in pretty well [in my department].” Although a less pronounced theme, Latinx students connected participation to SHPE to feelings of inclusion as well.

Sometimes it’s a little weird [in my engineering department], but there’s organizations like SHPE and fraternity where I don’t feel so alone. Compared to high school, I had more Hispanic friends, and here I don’t have many . . . Sometimes I just don’t know if it’s being homesick or missing talking Spanish or something, it feels a little off, I guess.

Together, these excerpts highlight how gender- and race/ethnicity-focused PEOs helped students fit into engineering, and how they were particularly helpful in white women’s and Black students’ fit. These PEOs are designed intentionally to serve people of specific groups who have shared experiences based on their gender, racial, and ethnic identities.

Instrumental Social Capital: Academic and Professional Knowledge and Networking

In their interviews, students discussed what they thought it took to be a successful engineering student and how their PEOs supported them in that endeavor. The main instrumental social capital findings related to:

- Alters met through PEOs helped students develop time management skills, which is crucial in excelling academically.
- PEOs provided mentoring opportunities where students were coached on what to expect, encouraged, and provided access to resources, such as study groups.
- PEOs provided students with socialization experiences, including practicing a range of professional skills, like communication norms and leadership opportunities.
- PEOs sponsored networking activities that provided access to people that could be useful in a student’s career path later or academic path now.

- PEO events, such as conferences and job fairs, where employers actively sought students to hire, directly aided students’ current career development.

In discussing how PEOs helped them manage their time, participants shared how alters met in PEOs helped them learn how to make time to support a healthy balance between self-care, school efforts, and participating in other activities. For example, a Black woman at a PWI shared that NSBE’s mission included three components: “excelling academically, succeeding professionally, and positively impacting the community.” The student described how she brings those three components into her life as she manages her various responsibilities and roles:

I get better every year, especially with time management . . . I make sure I get sleep because that’s really important. I lay off coffee. I talk to my teachers, my professors—the relationships with them—I go to office hours, I make that extra effort to make sure that I’m not behind in classes. I get tutoring. I tutor unofficially in the community with NSBE, just volunteering there and I’m a mentor now.

These skills of taking care of oneself and being one’s best academically are important for persisting in a challenging major. However, developing skills like time management can be difficult. Therefore, the PEOs encouraged students to practice managing their responsibilities.

Integrating instrumental and expressive social capital, a specific aspect of PEO programming that supported the development of academic skills occurred through mentoring programs. Many PEOs offer mentor programs in which a student who is further along in their program is paired with a student in the early stages of their program. For example, a white woman at a PWI described how her mentor from the American Institute of Chemical Engineers provided encouragement regarding her classes:

He helped me see what was coming the next semester because he’d already been through it . . . He knew the struggle. So just being able to talk to him about it and [him] being like, ‘Oh, well this class is going to be really difficult, but you can do it because I did it . . . He was more someone that I could talk to about the struggle that is chemical engineering just because he’d already been through it.

Likewise, a white woman at a PWI stated that being part of PEOs and having a study group working on particularly difficult academic tasks are essential to be a successful engineering student. She shared:

I’ve joined the study groups, . . . [in my fraternity] it gathers all these biomedical engineers together and it gives you the older people that have had a lot more experience in these classes that I’m taking now or have

experience with internships and jobs and things like that. They have a lot of really good advice to give to us younger kids, I guess I'm an upperclassman [now] technically, but like, I still feel like they can teach me so much. So having that has been like a really valuable resource too.

Similarly, a white woman at a PWI described her experience learning over time. She said:

I didn't recognize how important being in organizations, forming study groups, and getting leadership positions was. I didn't recognize how important it was to work with other students to pass your classes and plan an event for your club, so I wasn't in a lot of organizations. When I came here, I joined and it's a really good support system.

In addition to academic knowledge and skills, participating in PEOs provided students with socialization experiences tied to developing professional skills relating to norms of communication, appearance, and leadership. For example, a Latinx man at a PWI described his experience in SHPE developing a range of professional skills:

We do everything from professional workshops to social events. You want to get the club members interacting with each other, but you also want to do professional workshops. Like we have conference . . . So we held a conference readiness workshop beforehand on how to introduce yourself to someone, how to approach someone, what to have your resume look like, how to dress, how to present yourself, what to talk about, what not to talk about, how to act throughout the conference. So that's professionalism, interview workshops, all sorts of things like that.

In another instance, a Black man at a PWI discussed how being the publications chair of his NSBE chapter provided leadership practice that would help him in his future career. He said:

It's a great experience, it gets me experience being a leader and a servant leader . . . For me, being a servant leader is important because I want to do project management when I go in the workforce. So being a leader and understanding everybody's different gifts and being a servant to them and also leading them is something I believe in doing . . . so I want to build myself up for that.

For a Black man at a PWI, his role as a leader in the American Society of Mechanical Engineers impressed potential employers. He reflected:

I'm taking on more leadership roles than most people in my field. I've talked to employers at career fairs and events hosted by ASME. They tell me, 'Oh wow, you've

done a lot in your early years.' I'm like, 'Yeah, I thought that's what you're supposed to do.' He told me, 'Oh no, not a lot of people actually do that.' So, I'm standing there, 'Oh, okay. I guess I'm ahead of the game right now, that helps me stick out.'

Likewise, a Latinx man at an HSI mentioned "moving up" in SHPE to become a regional leader and developing a campaign to get elected. Similarly, a Black man at HSI described how the Society of Automotive Engineers "decided that I was fit to be a leader already" despite starting "off knowing nothing about cars."

Students built professional relationships through PEO-sanctioned networking activities helpful in their later career and current academic path. Connecting with professional engineers provided students access to career opportunities and advice. For example, a Black woman at a PWI shared that through NSBE, students "go to networking events, talk to company representatives and hand out their resume." Likewise, a white woman at a PWI described:

SWE definitely does offer a lot of resources and they do offer networking sessions for the community or the society. They give us a lot of heads up about events happening on campus, so that's beneficial.

Similarly, a Black woman at a PWI benefitted from NSBE without attending every event. She said:

Even last year when I wasn't going to every NSBE meeting necessarily, I still got emails about the corporate events, so I'd go to those . . . It's honestly when I have time . . . Right now, there's a lot of random events, you can just kind of go to whatever, but networking—whenever there's a company I'm interested in I'll go.

In another example, a Black man at an HBCU mentioned that attending NSBE meetings was helpful. When asked to explain how it was helpful, he identified that it facilitates his communication with various organizations beneficial to his persistence in his engineering program. He especially highlighted the role of NSBE in supporting him in this regard with people who were similar to himself:

I mean, it's networking skills. It's a bunch of other engineers that are also Black as well, [in the] same boat, go to my university, so that's how it's helpful. You can network very well, and just because you're in the same major as them, they're willing to help you. They're like, 'Oh c'mon, you need help with computing? Come here.'

In sum, PEOs created opportunities for women and URM students to network with professional engineers, often of the same gender or race/ethnicity, which enabled professional relationships supporting fit to form.

Participating in PEOs provided access to opportunities and experiences that aid in imminent career development, such as

allowing students to meet professionals and potential employers who were hiring or seeking interns. For instance, a Black woman at an HBCU, who was the treasurer of her university's NSBE chapter, stated that participating in such clubs gave her access to internships and networking opportunities:

I cannot stress enough sources, sources, getting involved. If you get involved in a lot of the engineering clubs, those help a lot because you can get internships, you can talk to corporate people. If you go to the fairs too, you can talk to jobs and they'll help you too.

Students felt confident that their PEO would help them land a good job. For example, a Latinx man at a PWI described his experience with SHPE:

All these kids ... now they work for major companies—Exxon, Goldman Sachs, Lockheed Martin. Every single person in SHPE got a job ... They knew what to do, they knew how to play the game, they knew what you had to do to get through, to get by and they had the best advice to give in my opinion. It's thanks to them, thanks to SHPE, thanks to my friend introducing me to SHPE, that's what's made the difference.

A Latinx man at a PWI also discussed the benefits of SHPE and ASME in employment. He said:

A lot of my friends who have gone to SHPE, [American] Society of Mechanical Engineers meetings, they've had opportunities to tour the local beer factory, study how machines work at the local theme park ... so if you go to SHPE you have a higher chance. I mainly went to SHPE for local meetings and just having my name out there.

In another example, a Black woman at a PWI shared, "I received 90% of my internship offers because of NSBE ... Through conferences and networking with the people there." In addition to networking to land job interviews, a white woman at a PWI discussed how her PEO mentor recommended an internship and provided support during the interview process.

I signed up for the mentor/mentee program through AIChE, and my mentor actually had the internship before me. He had quit because he was entering his senior year, it was just too much. They were like, 'Well do you have any friends who would like this internship?' And he's just like, 'Well, my mentee would really like this internship', and so I just had to send my resume and then they hired me.

These examples show the range of instrumental social capital, which intersects with expressive social capital, gleaned from participating in PEOs.

The Main Reasons for Joining PEOs Were Expressive: Encouragement From Others and Wanting to be Around People Like Oneself

The two main reasons students offered for why they joined PEOs include:

- They were encouraged to do so by alters.
- They wanted to join to be around people like themselves, particularly people who were similar to them racially.

First, students learned about and received recommendations to join PEOs from teachers, parents, friends, professors, mentors, resident advisers in engineering living-learning communities, and alters in a range of other settings, including classes, festivals, career fairs, and other events for first-year engineer students. For instance, a Black woman at a PWI said, "A former student advised me to join NSBE ... and then I did. And then it was just it's like a family, so I like it." A Latinx woman at a PWI also shared how her mentor encouraged her to get involved in discipline- and gender-focused societies, saying, "She's a civil engineer and I'm a civil engineer, so she was influencing me to join American Society of Civil Engineers, join SWE. I've acted on her advice." A white woman at a PWI discussed the major role of her resident adviser and of her engineering living-learning community in general in her awareness and involvement in PEOs:

We had a mentor and an RA that were both experienced engineering students, so they told us about every single organization and what they did and what their purpose was so that's where I heard about most of them. They also had an event at the beginning of the year where all of the organizations came to our floor and talked to us.

Second, in addition to identifying the advice of others to join PEOs, URM students were drawn to join race/ethnicity-focused PEOs, such as NSBE, because they offered a cohort of similar students with whom a student could experience the engineering program. Many students wanted to join because of the importance of seeing people "like themselves" succeed, which made them feel empowered in their studies and career and feel that they fit. For instance, a Black man at a PWI joined NSBE during his freshman year when he wanted to be part of a community of Black engineers. He described his experience:

It's [my experience in NSBE that's] cool. I wanted to get in extra-curricular groups and just have a well-rounded college experience because I just didn't want to be in the books. So, I joined NSBE because its National Society of Black Engineers, and so they're engineers that are Black and just like me and going through the same struggles. I like just going to those meetings, and then also being a part of an officer position.

When comparing NSBE and SWE in terms of effectiveness of their outreach to students, a Black woman at a PWI discussed

how her Black and white friends might choose a PEO based on such criteria as having “people like me”, field focus, or availability of scholarships. She shared:

I think some people just do NSBE, but my Black friends are all in NSBE. My white friends, I have one who's in a business frat because she just wants to do business, but then some of them are in SWE. So, I think you should have one engineering thing, at least that you're in. I might do SWE, I know SWE had scholarships that I haven't looked at and SWE since it's all women, I think it has a little bigger reach.

These excerpts highlight how a student's identity and the need to seek others with similar identities encouraged students' participation in PEOs.

Reasons for Not Joining PEOs: Lack of Time, Money, or Fit

Most students who did not participate in PEOs expressed an interest in participating, but often offered one of three main reasons for not joining a PEO:

- Students had an already packed schedule full of classes, commute time, or a job.
- The cost of dues was too high.
- Students were concerned that they would not fit in at the PEO because they did not yet have enough engineering knowledge or the environment may not have been welcoming.

The main time-related obstacles to participating in PEOs mentioned included course load, commuting, or having a job. For instance, when discussing how his academic workload prevented him from joining PEOs, a Latinx man at a PWI shared, “My sophomore year, I was focused on research and classes. There's not enough time in the day to do everything.” Similarly, a Latinx man at an HSI was not able to add any PEOs to his schedule, despite being interested in them. He shared:

There are a lot of clubs. There was a fair here last month . . . with a lot of engineering clubs. A lot seemed really interesting . . . But because I was taking a lot of higher level classes, I didn't want to get into them because I was already pretty swamped studying.

Similarly, a Black man at an HBCU prioritized studying over attending PEO meetings: “Nothing against them, don't get me wrong. They're helpful and all. It's just . . . I'm not going to go to every single meeting because I could be studying during that meeting.” Further, a Latinx man at a PWI described that his classes coincided with the meeting times. He said:

SHPE helps, [but] I don't go to their meetings often enough because I usually take calculus at night . . . SHPE meetings,

will be during those class times. The professor's office hours fall at the same time, too. I would go to four SHPE meetings out of fifteen because those are the meetings that work with my schedule.

Commuting compounded the issue of having limited time. A Latinx man at a PWI stated:

I didn't really go to any meetings last year, especially since I commute 30 minutes a day . . . Sometimes their meetings are at night and my classes are during the day, so I leave campus and then I don't really feel like driving all the way back, it's a long drive.

Similarly, a white woman at a PWI was limited in her ability to participate in SWE's activities because of the distance between the campus location where classes were held and where SWE holds its activities and events. She explained:

I'm part of SWE. I haven't participated too much with them because their meetings are every other week on Wednesday at seven . . . Since the engineering campus is off campus, it was always too much to go to my car and drive there.

Students who hold jobs while going to school have an additional time constraint. For example, a Latinx man at an HSI discussed how it was tough for him to be a successful engineering student because he worked part-time in a warehouse since he began his studies 2 years ago. He discussed how his day was already full:

I don't have time to be in a clubs because I have a job. Since my job takes a good chunk of my day, I can't spend a lot on anything else other than the three core things: going to school in the morning, working in the afternoon, and studying at night.

Other students were in a similar situation. A white woman at a PWI is not a member of any clubs “because I work as well as I'm taking a lot of credits in the semester, so I didn't think that I would have time to spend at the societies, but I will be doing that in the fall.” Similarly, a Black man at a PWI explained that his lack of involvement was due to having an internship in his first year of college.

Financial reasons influenced students' decisions to join a PEO. A Latinx woman at a PWI noted that whether she joins SHPE or not “depends on how much I can work and how much my mom can work as well.” A white woman at a PWI explained that the cost associated with being a PEO member made her think about how many hours of work she would need to afford it. Further, a white woman at a PWI shared, “I did actually go to a meeting at SWE, and then I didn't want to pay national dues.”

In addition, students' desire to participate in PEOs were influenced by their feelings of fit. Some students were concerned about whether they were ready to join PEOs given their knowledge and experience in engineering. For example, a man identifying as ‘other’ race or ethnicity (specifically, Chinese and Nicaraguan) at an HSI said that he was not interested in joining PEOs “because I still don't feel like I have the skills to really be in there. I haven't

completed that many classes.” When discussing her interest in joining a PEO, a Latinx woman at a PWI had similar views and assessment of her knowledge and readiness to be a member of a PEO. She explained:

I probably will join junior or senior year. Right now, I don't know that much about engineering. But once I can actually start more engineering-based classes, then maybe I will feel more like into being into the club and 'Oh, I can help in this club.'

A Latinx man at an HSI similarly remembered his first visit to one of the organizations and not being able to absorb the content:

I don't recall much of it because my mind wasn't ready to learn. My interest was not in what they were saying, so it just went right over my head. I didn't absorb everything, my mind was closed at the time.

In other cases, prospective PEO members, at times, did not feel like they fit into the PEO due to their intersectional identities (i.e., being a URM student in SWE, being a light-skinned Latinx student in SHPE). For example, for a Latinx woman at a PWI, SWE felt competitive and she did not feel included:

I haven't been as involved as I want to be in SWE, but SWE is kind of just a huge seminar body with all these women in it. We kind of just talk about struggles and like things like that . . . I don't know, whenever I went to a SWE thing, I didn't feel as included as when I went to like other things. I haven't felt that . . . I feel like a lot of the women, they're very competitive compared to men, which is really interesting.

A Latinx man at a PWI did not join SHPE because he felt he might have to perform *Latinidad* in a particular way given his intersectional identities (i.e., a Puerto Rican with blue eyes who speaks “unaccented” English).

So, my family's very Puerto Rican . . . but I mean I have no accent . . . I don't look Puerto Rican, I have blue eyes . . . I'm not a member of any societies, I've considered joining but I don't really - I mean I see the usefulness for a lot of people, it's not something that I want to do. Like even though, SHPE, even though I consider myself Hispanic, I feel uncomfortable in groups like that.

These remarks show the factors that impacted student participation in PEOs and their ability to reap the benefits associated with PEO participation.

DISCUSSION

In sum, previous research revealed positive impacts of joining PEOs, reporting that not joining a race/ethnicity-focused PEO is associated with a decreased likelihood of continuing in an engineering major for

URM students (Smith et al., 2021). Yet, the specific levers through which PEOs, as participatory social capital, may promote fit and reduce isolation were not entirely clear compared to the more clearly identified levers of network-based alters who can provide warnings of discrimination to promote fit (Campbell-Montalvo et al., 2021). Therefore, this study's primary goal was to understand better the mechanisms through which participation in PEOs affects persistence, focusing specifically on the CMES domain of fit. We highlighted how PEOs affect persistence mainly through expressive social capital that supported improved feelings of fit, like when students saw many people like themselves doing engineering. We also found that the provision of instrumental social capital was particularly well received by women and URM students in women-focused and race/ethnicity-focused PEOs because it was provided by homophilous alters (Brown and Josephs, 1999; Morganson et al., 2010; Borum and Walker, 2011; Evans et al., 2011; Joseph et al., 2017; Campbell-Montalvo et al., 2021; Leyva et al., 2021). In short, this study reveals how students become connected to PEOs, and how PEOs provided students access to instrumental and expressive social capital delivered by people with similar characteristics that affected fit consequential in persistence.

This study focused on students' CMES (i.e., their notions of what they needed to do to be successful as engineering students, including feeling that they fit) and highlighted their agency in locating and accessing resources (i.e., PEOs and the people in them) needed to enhance their feelings of fit. PEOs, particularly gender- and race/ethnicity-focused PEOs, have as part of their mission a goal to help students fit in and build their academic and professional capabilities to promote their success in STEM. What is particularly powerful about gender- and race/ethnicity PEOs is their acknowledgment that the STEM environment can be unwelcoming for women and URM students, and that participation in a supportive community can mitigate that feeling. We conclude that within the context of incongruities between women and URM students' CMES and institutional culture (Smith et al., 2015), PEOs play a vital role in encouraging students' persistence in engineering through expressive social capital affecting feelings of fit.

Because women and URM students encounter a less welcoming environment and see fewer people like themselves, expressive social capital provided by race/ethnicity-focused and women-focused PEOs provides added value because it provides access to homophilous alters who are successful in engineering. Engaging with homophilous alters with whom they could learn, discuss struggles, and share common experiences positively influenced students' feelings of fit. Obtaining social capital from homophilous alters was most beneficial because of the shared identities, perspectives, and comfort/trust between the ego and alter. This finding reinforces results from previous studies that highlight the importance of students having alters with whom they can consult when they experience difficulty in their engineering programs (Weston, 2019). These alters help students name and resist processes of marginalization (Secules et al., 2018; Campbell-Montalvo et al., 2021).

PEOs also provide instrumental social capital, including academic and professional skills, networking, and knowledge development opportunities. They help students develop professionalization skills and gain awareness of disciplinary

norms (e.g., how to talk, dress, or engage in ways accepted in the field). We acknowledge that foundations of disciplinary norms are grounded in the values of majority groups, and these norms and values are often assumed to be neutral (McGee, 2020). However, efforts should be made to address how institutional norms are often rooted in the values of majority groups. While STEM culture will not be changed overnight, making information about disciplinary norms explicit informs students and permits them to be more knowledgeable about actions that can be taken to impact how others perceive them, contributing to their feelings of fit and potentially leading to engineering persistence. Although industry- and discipline-based PEOs are valuable sources of instrumental social capital, we highlight how social capital provided by homophilous alters in women-focused and race/ethnicity-focused PEOs interacts with the academic climate and nature of inequality experienced by women and URM students.

Although participatory social capital may comprise less direct social relations between students and alters than the relationships established between students and alters in network-based social capital, it may accomplish similar outcomes, especially for marginalized students when they are receiving it from people like themselves. We found that participatory social capital helped women and URM students make sense of the treatment they received from others and improved their feelings of fit. We posit this social capital is especially beneficial for Black students. Indeed, it is likely that the higher rates of NSBE participation (Smith et al., 2021) are connected to the more pronounced threats to fit experienced by Black students (Campbell-Montalvo et al., 2021). Black students' increased tendency to seek assistance helpful in fit can be understood given STEM's anti-Blackness (Bullock, 2017; Cedillo, 2018; Martin et al., 2019; Vakil and Ayers, 2019; Nxumalo and Gitari, 2021).

Skvoretz et al. (2020) reported that students from various ethnic/racial groups enter their engineering programs with differing levels of social capital. Further, Blosser (2020) highlighted the role of initial social capital in developing more social capital useful in STEM success. We showed the crucial role of homophilous alters in students' persistence and acquisition of additional capital. Given the limited number of women and URM in engineering departments, the reactions to students' intersectional identities that can make it difficult for them to access capital open to some of their identities, and the differential treatment marginalized students may experience, it is vital to address existing gaps in social capital. If these gaps are not filled, students may be less likely to benefit from advice to take advantage of available resources such as PEOs, despite evidence that women and URM students will more often experience stereotype threats than their majority peers. Our study revealed that students joined PEOs because they were encouraged to do so and desired to be around people who were like themselves. However, some students could not take advantage of these opportunities because of obstacles that need to be addressed, such as inconvenient meeting times and the cost of dues.

Implications for Institutions

Results from this study offer insights to augment university and engineering degree program efforts to attract and retain women

and URM engineering students, particularly by harnessing PEOs to help support them and provide development opportunities. PEOs are a vital part of university efforts to broaden participation in STEM. In particular, universities should consider how PEOs can bolster or supplement engineering programs. Because of their impacts on students, universities and departments are encouraged to increase their relationships with PEOs and support student engagement in them. Increasing students' access to PEOs is paramount. To be inclusive, universities should attend to potential barriers to participation, such as when and where meetings and events occur and how to provide nontraditional and commuter students access. Additionally, departments can consider ways to reduce financial barriers to participation, such as covering the cost of students' dues.

Other strategies can be addressed programmatically. Programs such as engineering bridge programs, design teams, PEOs, and other valuable opportunities for students to build social capital and improve feelings of fit should be widely available and accessible (Campbell-Montalvo et al., 2021). Additionally, departments can encourage students to engage with PEOs by requiring them to explore their benefits by attending a few meetings, including exploring race/ethnicity- or gender-based PEOs as appropriate. Such experiences can provide students insights about resources and role models early on in their programs. Because we found that alters influence participation in PEOs, advisors in engineering programs can play a pivotal role in encouraging students, particularly students of color, to participate in PEOs. Students should be encouraged to participate early (e.g., first semester) to benefit from access to such resources fully. Our study also revealed that students benefit when they have access to homophilous alters. This reinforces the need to have a diverse engineering faculty that includes professors and advisors who are women and/or people of color.

Data from this study showed that PEOs might not be equally welcoming to all students, whether because students feel they lack engineering content knowledge or are concerned that they will not fit into the society. Professional societies can use this information to support changes in organizational culture and help make their programming more accessible (Campbell-Montalvo et al., 2020). We suggest that PEOs consider implementing an assessment and improvements of their programming as needed with an eye on diversity, equity, and inclusion (Peters et al., 2021).

Implications for Research

While this study advanced understandings about how PEOs affect engineering persistence, additional research is still needed. For example, students' pre-college socioeconomic backgrounds may be an important factor to consider in their PEO participation. Previous research has shown that Black and Latinx students' pre-college experiences may influence their ability to integrate into engineering programs at PWIs (Johnson, 2019). Indeed, such experiences could have influenced why students in our study participated in PEOs and in which PEOs they chose to participate. Although our sample included students enrolled in different types of university contexts (e.g., PWIs, an HBCU, and an HSI), we

did not address the role of university context in this study. However, we found that Latinx students talked far less about the benefits of participation in PEOs. It might be that Latinx students in our sample, particularly Latinx men, had higher rates of fit in their engineering degree programs, particularly if enrolled at an HSI (Campbell-Montalvo et al., 2021). Although we assert that PEOs are valuable for helping marginalized students fit into engineering programs, additional research is needed to uncover the influence of various university settings (e.g., HSIs and HBCUs with students from a range of racial/ethnic groups) on several factors including pre-engineering fit and social capital.

Campbell-Montalvo et al. (2021) showed that network-based alters, who are arguably more well known to students and have potentially closer social proximity, offered more personal advice about students' identities and how others would react to them. In the current study, participatory social capital improved fit by making role models accessible, allowing students to see people of similar characteristics achieving, permitting them to engage in discussions about engineering obstacles and how to overcome them, and helping them to receive professional and academic advice. Collectively, both network-based and participatory social capital are crucial for students' fit, and offer complementary resources helpful in STEM persistence. As noted in Johnson (2019), additional research is needed to determine the extent to which these findings are patterned in engineering and STEM, and how these types of social capital and CMES articulate for particular students. For instance, can having lower levels of network-based social capital be mitigated by participatory social capital? Does this differ across gender and ethnic/racial groups? What is the relationship among the varying levels of fit, types of social capital (network-based, participatory), and other forms of social capital (instrumental, expressive), and how do these relationships affect persistence? How do differences in fit and social capital within and between groups' pre-college experiences affect persistence?

Additionally, studies are needed that disaggregate data within categories, including those that disaggregate within URM categories and offer intersectional analyses for women of color. For example, Smith et al. (2021) found that URM students participate in PEOs at different rates—Black students participate in NSBE at higher rates than women in SWE and Latinx students in SHPE. So, conducting analyses that combine students from the various demographic groups may hide important differences. Similarly, we found that network-based alters (Campbell-Montalvo et al., 2021) and participatory social capital (i.e., participation in NSBE) played an important role in Black student persistence in engineering (Smith et al., 2021). Considered together, these findings suggest that using the URM as an all-encompassing category may obfuscate results, particularly as they relate to Black students, and reduce the efficacy of recommendations to support broader STEM participation. Likewise, other research reveals the challenges of using Asian as an umbrella category. For example, Kang et al. (2021) noted that such practices contribute to the gross

underrepresentation of southeast Asian students, such as Filipino, Hmong, Cambodian, and additional students.

Our finding related to influences on students' decision to participate in PEOs raises additional questions. For example, do the sources of advice to join particular PEOs differ across gender and ethnic/racial groups? How does the availability of alters (including whether they are homophilous) affect the receipt of such advice (see Johnson, 2019)? Answers to such questions can provide insights about social processes, including how the entry social capital of Black students interested in STEM affects their ongoing acquisition of social capital and its influence on fit, and persistence. A focus on Black students is warranted given their low representation in STEM, especially compared to other groups (i.e., women, Latinx students), and existing societal and STEM notions of anti-Blackness. Answering these additional questions could be valuable in informing theory and practices relating to STEM persistence across groups.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because of the need to preserve participant confidentiality. Requests to access the datasets should be directed to rebecca.campbell@uconn.edu.

ETHICS STATEMENT

This study involving human participants was reviewed and approved by the University of South Florida Institutional Review Board. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

RC-M and CS conducted the interviews in this research. RC-M, GK, CS, EP, and JM developed the interview analysis protocol for this research. RCM and EP coded the interviews. OS and HC, under the direction of RC-M, led the analysis. RC-M, OS, and HC drafted an initial version of this manuscript. All authors provided intellectual contribution in project development, research methods, analysis, and writeup. GK and HW provided additional writing and revision efforts.

FUNDING

This material is based upon work supported by the National Science Foundation under Grant #1664366 and Grant #1432297.

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